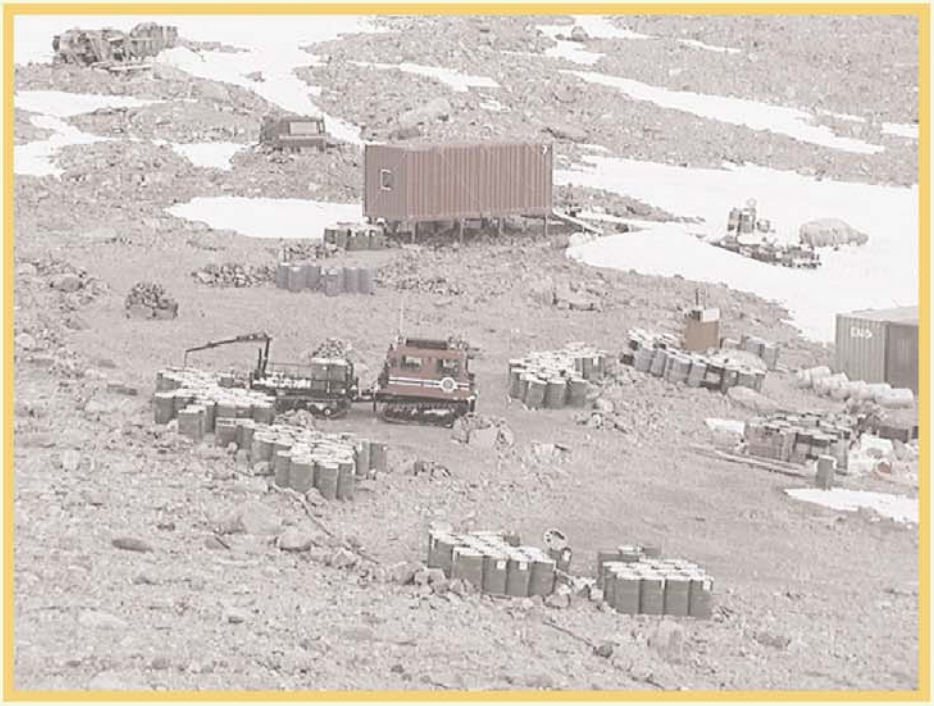

Birgit Njåstad

Multi-year Initial Environmental Evaluation for the operational aspects of Norwegian Antarctic Research Expedition 2000-2010

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The Norwegian Polar Institute is Norway's main institution for research, monitoring and topographic mapping in Norwegian polar regions. The Institute also advises Norwegian authorities on matters concerning polar environmental management.

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1 BACKGROUND

The following document is an Initial Environmental Evaluation (IEE) for the operational aspects of the Norwegian Antarctic Research Expeditions (NARE). The Norwegian Polar Institute, which is responsible operator for the Norwegian Antarctic expeditions, has prepared the IEE.

The document has been prepared in accordance with § 10 of the *Regulations relating to protection of the environment in Antarctica* (hereafter referred to as the Antarctic Environmental Regulations or AER), which states that anyone intending to start a planned activity in Antarctica shall prepare an initial environmental evaluation, containing a description of the proposed activity, including its purpose, location, duration, intensity, use of means of transport and evaluation of impacts, if any, on the environment. This provision reflects the intentions of Article 2 of Annex I to the Protocol on Environmental Protection to the Antarctic Treaty (Environmental Protocol).

The NARE operations cannot be defined as an on-going activity since every expedition is a new initiative. The Norwegian Polar Institute (NPI) nonetheless considers the NARE operations of such nature that the aspects covered by this IEE would hold true for all expeditions as they currently are implemented. The NPI therefore presents this document as a multi-year IEE, which will apply to all Norwegian Antarctic Research Expeditions which take place during 2000-2010 and which operates within the framework described in this document. The IEE, along with details for the expedition at hand, should be used as basis for consideration of all specific permit applications. The document will be reviewed on a regular basis and updated as needed.

In addition to the operational aspects of NARE, the expeditions furthermore consist of the research activity itself. Norwegian authorities consider each research project as a separate project and require separate IEEs prepared for each project. The evaluation of the research activity itself is therefore not included in this document.

2 SUMMARY

The present document describes the logistical activities associated with the Norwegian Antarctic Research Expeditions (NARE) in respect of their potential impacts on the Antarctic environment.

The NARE activity comprises vessel operations, aircraft operations (inter-continental and feeder-link activity), helicopter operations, ground transport (bandwagons and snow mobiles) and station operations. The activity primarily takes place in the eastern Weddell Sea area and in Dronning Maud Land (DML).

An operational framework has been defined in order to minimize environmental impact. Operation standards have been set, contingency plans have been developed and environmental guidelines are in place. Provided operations are carried out in accordance with this framework, it is expected that environmental impacts stemming from NARE operations will be minimal. Nevertheless there are some unavoidable impacts associated with the activity:

- Impacts on the glacial environment may occur due to changes in the structure of snow and firn, changes in snowdrift, to particle deposits as a result of combustion processes and to small amounts of littering.
- Air quality may be affected by emission of combustion products. This may further contribute to the overall climate forcing and global climate change.
- Water quality (both marine and inland) may be affected by small releases of fuel products and small amount of littering.
- Flora and fauna may be impacted by noise, pollutants and abrasion.

If the activity were not carried out (the 'no action' alternative) no impacts would be expected. On the other hand, researchers would be deprived of an important logistical framework which is necessary in order for them to carry out their research and thereby acquire knowledge to help improve our understanding of the natural and anthropogenic changes in the Antarctic and global environment.

Having taken all the above into consideration, the Norwegian Polar Institute has come to the conclusion that the unavoidable impacts associated with the NARE activity should be considered acceptable, and that they likely will constitute no more than minor or transitory impacts on the environment. On this basis the

Norwegian Polar Institute does not believe that the activity merits the preparation of a Comprehensive Environmental Evaluation.

3 INTRODUCTION

3.1 Purpose and need

The principle objective of the Norwegian Antarctic Research Expeditions (NARE) is to carry out research in order to acquire knowledge to help improve our understanding of the natural and anthropogenic changes in the global environment. The NARE research focuses primarily on:

- Biology
- Glaciology
- Paleoclimatology
- Physical oceanography
- Surveying and monitoring activities

3.2 Description of activity

Norwegian research activity in Antarctica is rooted in a long tradition. Already in the 1920s and 1930s Norwegian nationals carried through extensive research in Antarctica, most often on expeditions that combined whaling and research activities. The modern Norwegian Antarctic Research Expeditions (NARE) commenced in 1976, and expeditions now take place regularly. Since 1991 Norway has been part of a Nordic cooperation that entails that the three Nordic countries active in Antarctica take responsibility for the logistical arrangements of expeditions in turn. Consequently, there is a major Norwegian Antarctic expedition every third or fourth year, with smaller expeditions taking place in the intermittent years when Norway is not responsible for the logistics.

The following components are considered essential characteristics of present day NARE logistical activity:

- Vessel operations
- Aircraft operations (inter-continental and feeder-link activity) and helicopter operations
- Ground transport
- Station operations (Troll and Tor)

Each of these aspects is covered in the separate chapters of this document. An evaluation of impacts associated with the activity has been done for each of these operational aspects. A summary of those impacts that are unavoidable and which NPI believes should be accepted as such is presented in matrix form in Appendix 1.

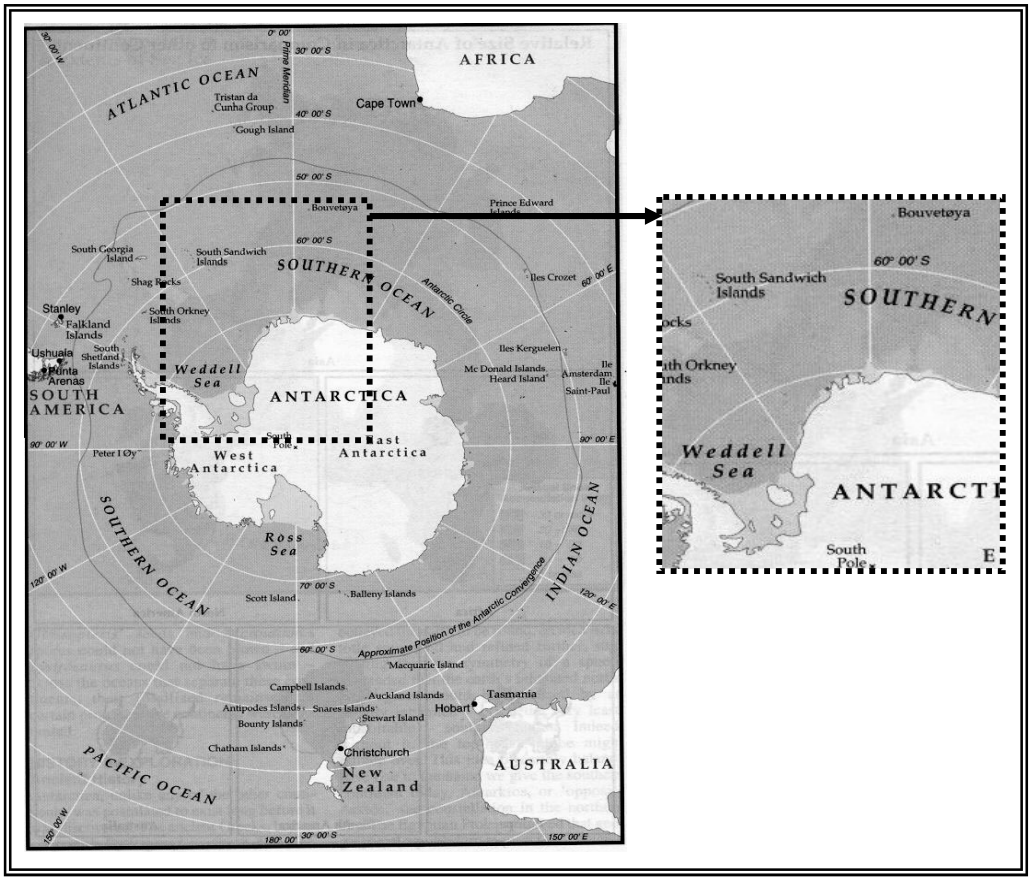
In addition to the above, the NARE activity furthermore consists of the research activity itself. Norwegian authorities consider each research project as a separate project and require separate IEEs prepared for each project. The evaluation of the research activity itself is therefore not included in this document.

3.3 Description of the environment

3.3.1 Geographic area

The main bulk of the NARE activity takes place in the South Atlantic sector of Antarctica, specifically the eastern Weddell Sea region and Dronning Maud Land. These areas have been designated as the main focus areas for Norwegian Antarctic research (NFR 1997). The area of interest is illustrated in Figure 1. Some activity may take place outside this area. Such activities will be evaluated in separate IEEs.

Figure 1: General area of interest for NARE operations



3.3.2 Marine environment

The sailing area is predominantly characterized by open water at the time of operations. However, patches of sea ice and icebergs can be encountered. Closer to the ice shelves medium thick 1-year sea ice of thickness 0.7 to 1.2 metres is likely to be encountered.
Diatoms and flagellates, as well as ice algae, constitute the main components of the plant plankton flora in the Weddell Sea area. The zooplankton composition varies somewhat with locality, but is dominated by the crustaceans (Euphausiacea) krill (especially *Euphausia superba*) and copepods, as well as arrow worms (Chaetognatha), siphonophores and salps. The bentic fauna consists mainly of sponges (Porifera) and moss animals (Bryozoa).

In the Weddell Sea, approximately sixty species of fish from eight different families have been registered. The fish fauna mainly consists of Nototheniids, but there are also skates (Batoidei), eelpouts (Zoarchidae) and sea snails (Liparidae). The pelagic notothenid *Pleuragramma antarcticium* is ecologically more important in the Weddell Sea than in other areas of the Antarctic seas, as it replaces krill as nourishment for the higher predators.

In the summer months, the most numerous species of marine birds and marine mammals are Weddell seal (*Leptonychotes weddelli*), crabeater seal (*Lobodon carcinophagus*), emperor and Adelie penguins (*Aptenodytes forsteri* and *Pygoscelis adeliae*), minke whale (*Balaenoptera acutorostrata*), southern bottlenose whale (*Hyperoodon planifrons*) and killer whale (*Orcinus orca*).

The Weddell Sea fauna has a low growth and reproduction level, and this ecosystem is therefore especially vulnerable to external influences and impacts.

3.3.3 Terrestrial environment

3.3.3.1 General

The terrestrial area of primary interest for NARE activities (Dronning Maud Land) is mainly covered by a thick ice sheet, which has an average thickness of 2,000 metres. Some areas are characterized by large crevasses. The ice sheet on the high plateau of Dronning Maud Land drains towards the sea, forming the shelf ice upon reaching the sea. A chain of mountains and nunataks is found approximately 100-250 km from the coast. The stations Troll and Tor are located on nunataks in this chain of mountains.

All nunataks are of great importance for plants and animals. Mosses and lichens are the most abundant plants. There is also algae and fungus. No fanerogams have been found so far. A number of invertebrates have been found, such as protozoan, bacterium, cyanobacterium, nematodes, rotifers, tardigrades and arthropods (i.e. insects, mites (*Acari*), springtails (*Collembola)* and fleas (*Siphonaptera*)).

Among birds Antarctic petrel (*Thalassoica antarctica*), snow petrel (*Pagodroma nivea*) and south polar skua (*Catharacta maccormicki*) are the most abundant species. They normally have their nesting grounds on steep cliffs. Wilson's storm petrel (*Oceanites oceanicus*) has also been observed a number of times, but just a few nests have been observed so far.

Emperor penguins (*Aptenodytes forsteri*) and Adelie penguins (*Pygoscelis adeliae*) are the only penguin species breeding in Dronning Maud Land. Emperors breed on the sea ice at three different locations: Riiser Larsen-peninsula, Lazarev Ice Shelf and close to the German station Neumayer. In the eastern part of DML there are a number of small colonies of Adelie penguins.

3.3.3.2 Troll

The Troll station is located in the Grjotlia nunatak in Jutulsessen (72º00'S, 2º32'E). Jutulsessen is located approximately 200 km from the ice edge (for location see Figure 2 on p. 17).

The terrestrial biota in the area is very restricted in species diversity and abundance compared to other areas. No rare species have been observed. Invertebrate fauna is found in association with the vegetated areas[1].

The vertebrate fauna consists of birds only: snow petrel (*Pagodroma nivea*), Antarctic petrel (*Thalassoica antarctica*) and south polar skua (*Catharacta maccormicki*). Two large snow petrel colonies are located in the central parts of Jutulsessen, approximately 10 km from the station area. Breeding south polar skuas are registered in Jutulsessen, while non-breeding young skuas are observed in the vicinity of the petrel colonies. In the station area itself, only a small number of breeding and non-breeding south polar skuas and snow petrels have been observed.

3.3.3.3 Tor

The station Tor is located at the Svarthamaren nunatak, at 71º53'S, 5º10'E (see Figure 2 for the station location).

The vegetation at Svarthamaren is sparse compared to the western parts of the Mühlig-Hofmannfjella[2]. There is a rich micro fauna consisting of midd (*Eupodes angardi*, *Tydeus erebus*), protozoa, nematodes and rotifers, as well as one insect species (*Cryptopygus sverdrupi*). No rare species have been identified.

[1] Flora registered at Troll : lichens (*Acarospora, buellia, Candelariella hallettensis, Lecanora expectans)*, Green algae (*Prasiola crispa, "Pleurococcus", Ulothrix),* Blue-green algae (*cyanobacteria*),
Invertebrate fauna registered at Troll: protozas, rotifers, nematods, tardigrads, midd (*Eupodes angardi, Tydeus erebus, Maudheimia wilsoni*), one insect species (*Cryptopygus sverdrupi*).

[2] Flora registered at Tor: The green algae *Prasiola crispa* is the only species that has been observed in any significant amount. One species of the algae *Chlamydomonas* is also registered. In addition the following lichen species have been registered: *Candelariella hallettensis* and *Rhizoplaca melano-phthalma*. Also lichen species of the family *Umbilicaria* and *Zanthoria* have been observed.

There are large colonies (approx. 250,000 breeding pairs) of Antarctic petrel (*Thalassoica antarctica*) in the northeastern mountainsides of Svarthamaren, south of the station area. In addition, there are populations of snow petrel (approx. 500-1000 breeding pairs) and south polar skua (approx. 50 pairs). A large number of non-breeding petrels and skuas are located in the area.

4 MARINE OPERATIONS

4.1 Purpose and need

Vessels in NARE operations serve three primary purposes:

1) Transport of equipment which is too heavy for air transport or which for other reasons cannot be transported by air.
2) Being a platform for marine research in the NARE programme.
3) Transport of personnel to the continent.

Although the latter is likely to become less of a reason for using vessels as air transport becomes the primary modus for such transport, vessels are still irreplaceable for transport of heavy equipment and as platform for marine research.

Small boats or rubber boats (zodiacs) may be required for specific research projects.

4.2 Description of activity

The framework described in this section is an underlying assumption about the vessel operations. Operations not in accordance with this framework either warrant a separate IEE or result from an emergency situation.

4.2.1 Type of activity

The activity consists of normal vessel operations associated with i) transport of equipment/personnel and ii) conducting marine research. The activity also encompasses use of small boats/zodiacs in research projects.

4.2.2 Geographic framework

NARE marine operations take place in the South Atlantic sector of the Southern Ocean, in the area between South Africa and Dronning Maud Land. The main emphasis of the activity takes place in the eastern Weddell Sea and along the coast of western Dronning Maud Land (20ºW – 10ºE). Vessels are also likely to be used in conjunction with transport of personnel and equipment to the sub-Antarctic island Bouvetøya, as well as marine research around the island. The area of interest is illustrated in Figure 1.

4.2.3 Temporal framework

NARE marine operations normally take place in the period primo December to primo March in the period when the ice conditions are considered the least complicated. Ice conditions should generally be no worse than occurrences of medium thick 1-year sea ice of thickness 0.7 to 1.2 metres.

4.2.4 Operational framework

4.2.4.1 General

It is assumed that Norwegian owned and operated vessels are used during NARE operations. If NPI charters vessels flagged in other countries than Norway for the operations, the same framework as described below will be required as a basis for operations. If operations are significantly out of line with this framework, a separate IEE will be developed for the activity. During years which Finland or Sweden are responsible for the common logistics of the Nordic Antarctic operations, foreign vessels are likely to be used. The country responsible for the common logistics is also responsible for the evaluation of the impacts of the operations.
It is furthermore assumed that vessel operations will be carried out in accordance with any international agreement that Norway has agreed to that relates to vessel operations in general and to vessel operations in Antarctic waters specifically.

4.2.4.2 Technical aspects

- Vessel type: Vessels used during NARE are classified as cargo ships and/or research vessels suitable for polar operations.
- Vessel size: The size of vessels used during NARE operations is not likely to exceed 80 metres or 4000 ton gross tonnage.
- Ice class: Vessels used during NARE operations are ice strengthened, classified at least as DnV ICE 1A (or similar classification from other approved classification societies) for operations in severe ice conditions, where ice floes of 0.8 m thickness are anticipated.
- Fuel type: Vessels used during NARE operations will utilize MGO or similar light marine diesel fuel with reduced sulfur content. Sulfur content will not exceed 0.2% (weight)[3].
- Ballast water: In order to maintain ship stability ballast water will be taken onboard to compensate for fuel used. Unless an emergency situation arises, there wil be no need to discharge this water until refuelling upon return from the Antarctic.
- Small boats: Rubber boats of the zodiac type with two-stroke engines (30 horsepower) are usually utilized. Four-stroke engines (which would have less combustion products) are presently not used due to their weight and the complexity of on-the-spot maintenance.

4.2.4.3 Waste management

Waste management during vessel operations will be carried out in accordance with national regulations *Forskrift om hindring av forurensning fra skip m.m.*[4] and the *Antarctic Environmental Regulations* (with respect to sewage)[5]:

- No waste with the possible exception of food wastes will be disposed of into the sea in Antarctica (south of 60º S). No waste will, unless it cannot be avoided due to unexpected circumstances, be disposed of into the sea north of 60ºS.
- Food waste might, if no option for storage exists, be disposed of into the sea, although no closer than 12 nautical miles from the nearest land or ice shelf, and only after having been passed through a comminuter or grinder.
- The vessels utilized will have sufficient capacity to store waste (with possible exception of food waste) while operating in the area, and there will be arrangements for transfer of such waste to receiving station.
- Sewage will not be discharged into the sea within 12 nautical miles of land or ice shelves.
- No incineration of the following products will take place: PCBs, waste with traces of heavy metal, refined petroleum products with halogen compounds or PVC products.

4.2.4.4 Management of fuel and hazardous substances

Fuel management during vessel operations will be carried out in accordance with national regulations *Forskrift om hindring av forurensning fra skip m.m.*[6]:

- No oil-contaminated water will be discharged into the sea south of 60º S.
- No noxious substances carried in packages (marine pollutants according to the IMDG code) will be disposed of into the sea.

4.2.5 Mitigation measures in place

The following mitigation measures will be in place in accordance with *Forskrift om hindring av forurensning fra skip m.m.*:

- The vessel will have onboard a contingency plan (Ship Board Oil Pollution Emergency Plan). Such a plan is required for all vessels larger than 400 ton gross tonnage. Vessels not covered by this provision will be required to prepare such a plan in accordance with § 24 of the Antarctic Environmental Regulations.

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[3] Cf. § 3 of *Forskrift om svovelinnhold i ulike oljeprodukter* (1995) (Regulations relating to sulfur content in oil products).

[4] Regulations pertaining to the prevention of pollution from ships. Disposal of waste in special areas (incl. Antarctica) is covered by § 5-5 (2) of the Regulations.

[5] Reference is also made to provisions of Annex VI of MARPOL which Norway has ratified and which therefore will apply to vessels used during NARE operations

[6] Regulations relating to the prevention of pollution from ships. Provisions relating to controlling pollution during operations is covered by § 2-5 of the Regulations; provisions relating to the prevention of pollution from packaged harmful substances by § 4-8.

- Storage of hazardous substances will be in accordance with Chapter IV of the regulations, which specifies provisions relating to packing, labelling, documentation, storage and limits to amounts in order to prevent pollution due to discharge of noxious substances carried in packages.

The following mitigation measures will also be in place:

- The vessel will be equipped with absorption equipment in order to handle small spills on deck.
- Ship crew will be instructed in relevant provisions of the legislation and any guidelines developed for the purpose.
- All operations of small boats/zodiacs will be in accordance with relevant NARE guidelines, in particular "Environmental Guidelines: Flora, fauna and the natural environment"[7].

4.2.6 Acts in contravention to the framework

No acts in contravention to the above-described framework shall occur during operations. It should be noted that non-intended acts in contravention with the framework is a result of an accident and might be considered an emergency situation.

4.3 Alternatives to activity

4.3.1 Not using vessel for operations

Not using vessel for the national Antarctic operations is not considered a viable alternative if Norway is to continue to conduct its own marine and/or terrestrial research programme in Antarctica. Vessel operations are required for transportation of equipment and as platform for marine research. Cooperation with the Nordic countries (and others) ensures that vessel operations are conducted in an efficient manner.

4.3.2 Different temporal framework

Other timing of operations will increase the risk of accidents and emergency situations due to higher risk of incidents in ice covered waters. This is not considered a viable alternative.

4.3.3 Different geographic region

Norway's primary research interests in Antarctica have traditionally been in the area around and in Dronning Maud Land. This is likely to continue to be the main area of focus. Operations in other areas would not satisfy the national strategy for Antarctic research.

4.4 Identification and evaluation of impacts and proposed mitigative measures

The impacts identified in Table 1 are those impacts that can be expected assuming that the vessel operations are in accordance with the framework defined in the above sections. A summary of those impacts that are unavoidable and which NPI believes should be accepted as such is presented in matrix form in Appendix 1.

A major oil spill due to structural damage to the hull of the vessel is not considered an incident which is to be associated with the activity. The operational framework should ensure that the risk of such an incident occurring is minimal. Only an emergency situation can lead to such an incident during NARE operations. Marine spills in general, and due to such incidents in specific, have occurred very infrequently in Antarctica (COMNAP, 1999).

[7] Found in Chapter 1 of the Nordic Environmental Handbook for Antarctic Operations.

Table 1: Potential Environmental Impacts due to Vessel Operations

Impact	Description	Evaluation	Mitigation	Litreature
Air				
Contamination due to burning of fossil fuel (power and transportation).	Compounds will be spread and diluted in the atmosphere. Contributes to the change in the composition of the global atmosphere.	**Certain** **Global** **Less than minor** **Transitory**	• Use of 'clean' (low sulfur) marine diesel to ensure 'clean' combustion.	> Appendix 2 for emission values
Contamination due to incineration of waste.	Compounds will be spread and diluted in the atmosphere. Contributes to the change in the composition of the global atmosphere.	**(Certain**[8] **Global** **Less than minor** **Transitory)**	• No incineration of waste shall take place unless incineration temperature can be kept above 1000°C to ensure 'clean' combustion.	
Water and Sea Ice				
Pollution due to accidental discharge of small amounts of fuel and oil contaminated water.	Spill will dilute and evaporate relatively quickly due to type of fuel and the small amounts. It has been shown that small spills disappear quickly from the marine environment. Evaporation, dilution, winds and currents are effective removal processes. It has also been shown that beaches can recover relatively quickly after being polluted by oil and fuel.	**Likely** **Local** **Less than minor** **Transitory**	• Routinely check for spillages and ensure easy access to absorbents etc.	> Cripps, G.C. and J. Shears (1997) > Kennicutt, M.C. *et al.* (1991) > Green, G. *et al* (1992)

[8] Not all vessels will have incinerators installed.

Table 1 Cont.

Impact	Description	Evaluation	Mitigation	Litreature
Littering/pollution due to accidental loss of garbage.	Some littering may be expexted due to carelessness, wind, etc. The amounts are likely to be so small that no accumulation of wastes will occur in the marine environment, but could contribute to the problem of littering of Antarctic and sub-Antarctic beaches.	**Very likely** **Local** **Less than minor** **Permanent**	• Routinely check for possible discharge points and handle the problem. • Routinely pick up loose waste so as to avoid it being taken by wind, etc.	> Walker, T.R. *et al.* (1997)
Contamination due to paint scraped off vessel hull during breaking through ice.	While operating in Antarctic waters, and especially when breaking through ice, antifouling paints can be worn off the ship side. Some substances in antifouling paints have proven to emit toxic chemicals and thus be potentially harmful in large concentrations (e.g. Tributyltinn – TBT). The problem is, however, greatest in areas of intensive shipping.	**Possible** **Local** **Less than minor** **Semi-permanent**	• If possible use vessels with wear-resistant 'ice-paint' above water line. • If possible use vessels not utilizing Tributyltinn.	> Evans, S.M. (1999) > Hofer, T. (1998)
Flora and Fauna				
Harm flora and fauna by accidental discharge of fuel and oil contaminated water.	Spills may cause harm to single individual animals in the immediate vicinity of the vessel or nearby shores, by e.g. contamination, damage to insulating fur/feathers, effects on metabolism, etc.. Low levels of pollution might not necessarily impact behaviour or mortality of marine mammals, however. Should a larger spill occur in the vicinity of a colony of seabirds or marine mammals, the impacts could be much more severe, but as there are few large colonies in the NARE area of operation, this is not considered a likely incident during operations.	**Not likely** **Local** **No more than minor** **Permanent**	• Routinely check for spillages, and ensure easy access to absorbants etc.	> Jenssen, B.M. (1996) > Hofer, T. (1999) > Fowler, G.S. et al. (1995) > Culik, B.M. et al. (1991)

Table 1 Cont.

Impact	Description	Evaluation	Mitigation	Litreature
Harm marine fauna due to littering.	Litter/garbage may be a potential danger to individual animals, most likely at beaches where the debris washes up. There are numerous examples of eg. seals getting entangled in such materials. The amount of litter from NARE operations is likely to be very low, and consequently not a great risk for such incidents.	**Possible** **Local** **Less than minor** **Transitory**	• Routinely check for possible discharge points and handle the problem. • Routinely pick up loose waste so as to avoid it being taken by wind, etc.	> Arnould, J.P.Y., J.P. Croxall (1995) > Isaksen, K. *et al.* (1997)
Disturbance to animals due to noise from vessel operations.	Operations may disturb individual animals in the immediate vicinity of the vessel, causing increased stress level. This may especially hold true when vessel is breaking through ice. The level of such disturbance is not well known.	**Not likely** **Local** **Less than minor** **Transitory**	• If large concentrations of animals are encountered during sailing, attempts will be made to detour.	> Cosens, S.E. and L.P. Dueck (1993) > Lesage, V. *et al.* (1999)

5 AIRCRAFT AND HELICOPTER OPERATIONS

5.1 Purpose and need

Use of aircraft in NARE operations is considered essential for the following reasons:

1) Efficient transport to/from the continent; personnel does not have to spend non-efficient time at sea.
2) Efficient transport within the continent - less time and resources spent on ground transport of personnel to/from place of arrival/departure.
3) Flexibility as to when to get personnel to the continent; can accommodate needs of research project
4) Efficient time on the continent; personnel does not have to spend more time on the continent than necessary.

5.2 Description of activity

The framework described in this section is an underlying assumption about the use of aircraft and helicopters in NARE operations. Operations not in accordance with this framework either warrant separate IEE or result from an accident/emergency situation.

5.2.1 Type of activity

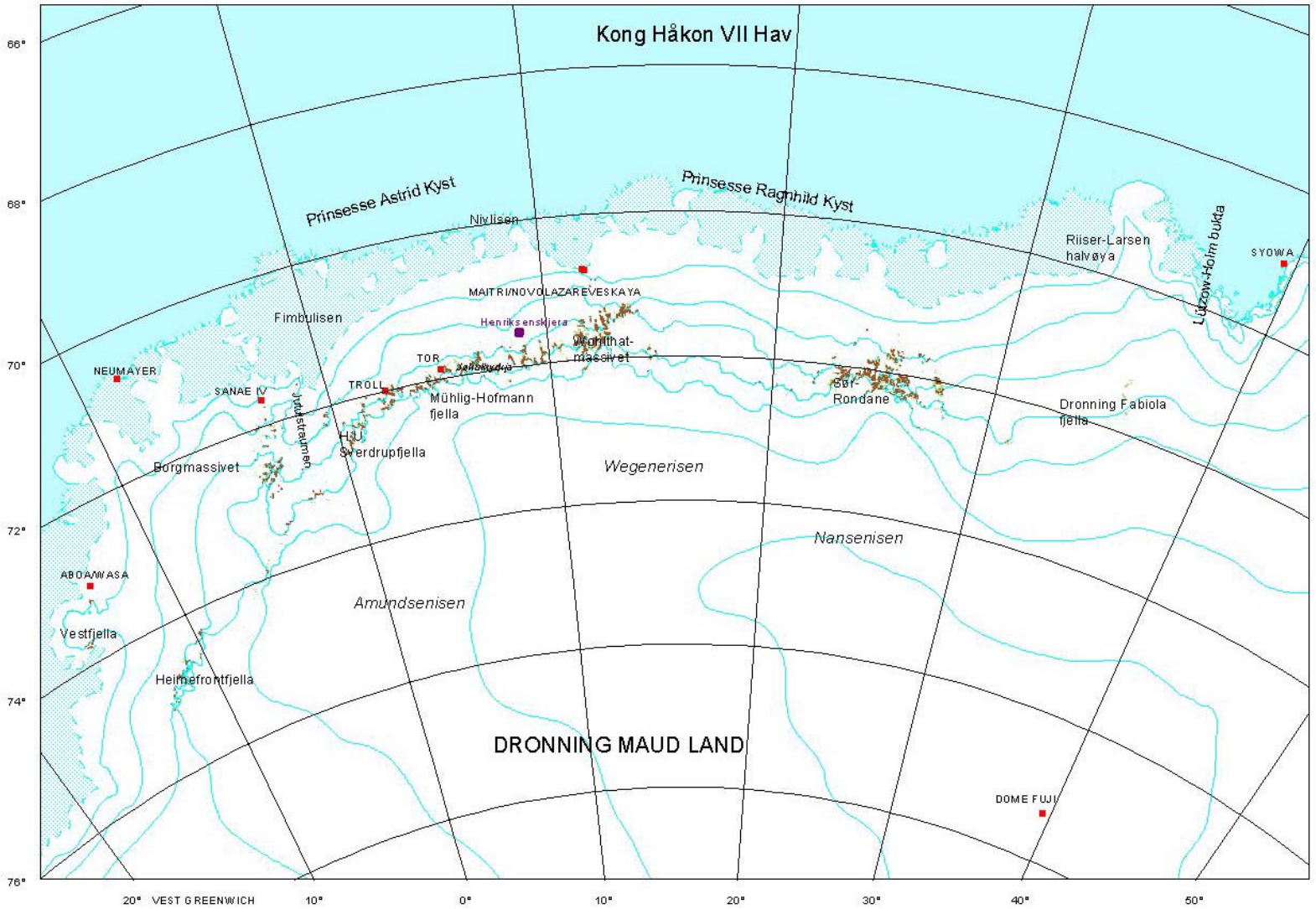
The activity consists of aircraft operations for the purpose of transport of personnel (and equipment) to/from the continent and for the purpose of transport of personnel (and equipment) to/from the field to/from Henriksenskjera where the intercontinental flights arrive/depart.

The activity furthermore consists of helicopter operations for the purpose of transport of equipment from/to vessel, for transport of research parties to the field and for use in implementing fieldwork.

5.2.2 Geographic framework

Transport to/from the continent takes place in a direct link between Cape Town and Henriksenskjera (71º31'S, 08º48'E). Intra-continental flights will normally take place in the area west of Henriksenskjera, and transport will normally be provided to/from the Norwegian field stations Troll and Tor (see Chapter 3 and 7). In some instances transport may be provided directly to area of field operations. The area of interest is illustrated in Figure 2.

Figure 2: Dronning Maud Land



Helicopter flights will take place between the vessel and the field stations Troll and Tor. Helicopters may be used in the whole area of research interest, ie. in the Weddell Sea area, as well as most of western Dronning Maud Land.

5.2.3 Temporal framework

Flight operations will take place during primo November to primo March which is the period when flight operations are considered safe.

5.2.4 Operational framework

5.2.4.1 General

It is assumed that air operations will be in accordance with the framework given below. If operations are significantly out of line with this framework, a separate IEE will be prepared for the activity.

5.2.4.2 Aircraft operations

NPI may charter aircraft operations from Polar Logistics[9], the logistic arm of Adventure Network International (ANI)[10]. These companies have experience in operating in the area and a high level of safety, as well as a well-developed environmental profile. Polar Logistics has developed an IEE for their flight operations to and in Dronning Maud Land (Poles Apart 1997). Polar Logstics, through ANI, operates its passenger traffic under annual permit from the UK Foreign & Commonwealth Office (Overseas Territories Department). The permit is granted on basis of the environmental impact assessment under legislation comparable to the Norwegian Antarctic Regulations. During NARE operations it is a prerequisite that ANI operates in accordance with a permit granted by UK authorities. Taking this assumption into account, *it is not considered necessary to do any further environmental evaluation of the operational aspects of the ANI flight operations*. If ANI fails to renew its permit for passenger operations, NPI shall consider ANI's IEE separately.

The NPI will explore the possibility and potential of chartering flights from other agencies (federal or private) than Polar Logistics. Such operations will be planned as to be conducted within a similar environmental framework as that of Polar Logistics. A separate IEE will be required and developed for such flight operations.

During years in which Finland or Sweden is responsible for the common logistics of the Nordic Antarctic operations, other agencies might be used for flight operations. The country responsible for the common logistics is also responsible for the evaluation of the impacts of the operational modus chosen.

5.2.4.3 Helicopter operations

- Helicopter type: NPI does not have its own helicopters and helicopters used in NARE operations therefore varies from expedition to expedition, depending on a number of factors (availability, cost, field needs, etc.). Most commonly used are helicopters of the type Ecureuil, ie. small single engine helicopters.
- Intensity of use: The number of helicopter hours varies depending on the needs during an expedition, and ranges between nil hours and 300 hours. Normally the intensity of use can be expected to be around 50 – 100 hours during those seasons helicopters are utilized.
- Fuel type and consumption: Fuel of type Jet A-1 (kerosene) is utilized for helicopter operations. The amount of fuel spent depends on the type of helicopter, but an estimated 200

[9] For more information on Polar Logistics: http://www.polarlogistics.com/
[10] For more information on ANI: http://www.adventure-network.com/home.html

litres are spent per flying hour. Appendix 2 gives an overview of average emission values from helicopter and aircraft operations. Jet A-1, the fuel used for both helicopter and small aircraft operations contains no lead or other heavy metals.

- Fuel storage: NPI stores fuel for helicopter and flight operations at Troll. Environmental aspects regarding the fuel storage are covered in Chapter 7.

5.2.4.4 Waste management framework

Waste management during air operations will be in accordance with national regulations – Antarctic Environmental Regulations- as well as strategy/plan set out in *Antarctic Waste Management Handbook for Nordic Antarctic Operations*[11]:

- All waste generated during transport will be collected and brought to the station for proper storage/removal.
- Human waste and spill water generated during air operations may be disposed of in ice-cracks or ice pits. No organic waste will be disposed of on ice-free ground.

5.2.4.5 Management of fuel and hazardous substances

Fuel management will be in accordance with national regulations – Antarctic Environmental Regulations – and no harmful products/substances will be disposed/ emitted during transport operations. This does not preclude combustion emissions from aircraft/helicopters.

5.2.4.6 Conservation of flora and fauna

Transport operations will be conducted in such a manner that provisions related to the conservation of flora and fauna in the Antarctic Environmental Regulations are complied with, i.e. harmful interference due to traffic will be avoided by adhering to *inter alia* guidelines set out in the "Nordic Environmental Handbook for Antarctic Operations".

5.2.4.7 Protected areas and historic remains

The Regulations relating to the protection of the environment in Antarctica are fundamental in considering air operations in relation to protected areas:

- No aircraft will land in a protected area unless special permission has been granted.

Furthermore, in accordance with the Management Plan for Site of Special Scientific Interest No. 23 (Svarthamaren), no flying of aircraft will be allowed over this protected area which is the only protected area in the area of interest for NARE operations.

5.2.5 Acts in contravention to the framework

No acts in contravention to the above-described framework shall occur during operations. It should be noted that non-intended acts in contravention with the framework is a result of an accident and might be considered an emergency situation.

5.2.6 Mitigation measures in place

The NPI has, in co-operation with its Finnish and Swedish counterparts, developed environmental guidelines that have relevance for aircraft and helicopter operations. All intra-continental flights and helicopter use in NARE operations will be required to adhere to these guidelines:

- Guidelines for operations of small aircraft and helicopters in Antarctica[12]. A short version of the guidelines is attached as Appendix 4.
- Procedures for fuel storage, transfer and transport Appendix 5).
- Oil Spill Contingency Plan[13] (with Fuel spill response guidelines, attached here as Appendix 6)

[11] "Antarctic Waste Management Handbook". 1998. Found in Chapter 3 of the Nordic Environmental Handbook for Antarctic Operations.

[12] 'Helicopter and Aircraft Operations in Antarctica – Environmental Guidelines'. 1999. Found in Chapter 6 of the Nordic Environmental Handbook for Antarctic Operations.

- Waste Management Handbook including waste management strategy (short version of Waste Management Guidelines are attached in Appendix 7).

The following mitigation measures will also be in place:

- All helicopters will be equipped with spill kits with basic spill response equipment.
- Pilots will be instructed in relevant provisions of the Antarctic Environmental Regulations and any guidelines developed for the purpose.

5.3 Alternatives to activity

5.3.1 Not using aircraft or helicopters for operations

NARE has up to the 00/01 season been based solely on vessel transport of personnel. This would still be a viable, although not very time efficient or economical alternative. The flexibility gained in basing NARE on aircraft operations is considered essential. The flexibility also entails that it is possible to minimize the length of stay for personnel, thus limiting the pressure on the stations and surrounding environment. Increased use of aircraft may, however, lead to a larger number of personnel in the future. NPI will keep an eye on the development and effectuate any measures necessary to avoid increased pressure on the environment of the area of operation.

Flying to the continent entails less combustion emission than utilizing a vessel for the transport equipment and personnel to the continent, this assuming that the expedition would need a separate vessel for the transport, ie. it would not be possible to use a vessel already operating in the area.

Due to the distances to be covered and the limited time available it is not considered a viable alternative to replace helicopter transport with ground transport. Such a solution would not likely have less environmental impacts.

5.3.2 Different temporal framework

A different timing of the flight operations will increase the risk of accidents and emergency situations due to difficult flight conditions. This is not considered a viable alternative.

5.3.3 Different geographic region

Norway's primary research interests in Antarctica have traditionally been in the area around and in Dronning Maud Land. This is likely to continue to be the main area of focus. Aircraft and helicopter operations in other areas would not satisfy the national strategy for Antarctic research.

5.4 Identification and evaluation of impacts and proposed mitigative measures

As described above, no further assessment of environmental impacts of the ANI flight operation is considered necessary, taking into account the IEE prepared by ANI, on which basis UK grants permits for operation. Evaluation of impacts due to landing of aircraft at the field stations Troll and Tor are considered in Chapter 7.4.

The impacts identified in Table 2 are those impacts that can be expected assuming that the aircraft and helicopter operations are in accordance with the framework defined in the above sections. A summary of those impacts that are unavoidable and which NPI believes should be accepted as such is presented in matrix form in Appendix 1.

[13] "Oil Spill Contingency Plan for Norwegian Antarctic Operations". 1999. Found in Chapter 4 of the Nordic Environmental Handbook for Antarctic Operations.

Table 2: Potential Environmental Impacts from Air Operations

Impact	Description	Evaluation	Mitigation	References
Air				
Contamination due to burning of fossil fuel.	Compounds will be spread and diluted in the atmosphere. Contributes to the change in the composition of the global atmosphere.	**Certain** **Global** **Less than minor** **Transitory**	• Avoid unnecessary flights and combine errands.	> Appendix 2 for emission values
Ice covered ground				
Pollution due to accidental spills of small amounts of fuel and lubricants.	Small fuel spills are to be expected during re-fuelling or due to small leaks, etc. Small areas of ice-covered ground may be contaminated. Spill that cannot be removed mechanically will partly evaporate and partly be encapsulated in firn/ice.	**Very likely** **Local** **Less than minor** **Transitory**	• Adhere to guidelines given for refuelling and maintenance.	
Flora and Fauna				
Impact	**Description**	**Evaluation**	**Mitigation**	**References**
Disturbance to animals due to noise.	Should an aircraft approach a bird colony too closely a general uneasiness amongst the birds is to be expected, and the birds may leave the nest temporarily. In the breeding season, eggs may be lost and opportunistic predators (e.g. skua) may take chicks. Unless approach reoccurs, birds are likely to settle down again without significant impact to the population.	**Possible** **Local** **No more than minor** **Transitory**	• Adhere to guidelines for helicopter and aircraft operations.	> Olson, O. and G.W. Gabrielsen (1990) > Fjeld, P.E. *et al.* (1988) > CAFF (1998)

6 GROUND TRANSPORT

6.1 Purpose and need

Use of ground transport in NARE operations has two primary purposes:

1) Transport of equipment between the stations and ice-edge (vessel)
2) Transport of personnel during field operations

6.2 Description of activity

The framework described in this section is an underlying assumption about ground transport operations. Operations not in accordance with this framework either warrant separate IEE or result from an emergency situation.

6.2.1 Type of activity

The activity consists of the following two components:

a. Bandwagon transport. Bandwagon transport is mainly used for transport of equipment from the ice edge to the stations, but is also used for some larger research projects.
b. Snow mobile transport. Snow mobiles are mainly used for research activities in the field. The number of snow mobiles used during a season varies depending on the number of researchers and type of projects.

6.2.2 Geographic framework

NARE ground transport operations occur in Dronning Maud Land, mainly in the western region. The area of interest is illustrated in Figure 2 (p. 17).

6.2.3 Temporal framework

NARE ground transport operations normally take place in the period primo November to primo March.

6.2.4 Operational framework

6.2.4.1 General

It is assumed that ground transport operations will be in accordance with the framework given below. If operations are significantly out of line with this framework, a separate IEE will be prepared for the activity.

6.2.4.2 Technical aspects

- Band wagons: NARE utilizes bandwagons of type BV 206 Hägglunds. No more than three wagons are necessary for operations. The bandwagons utilize Jet A-1 fuel, approx. 1.3 litres/km with no cargo, and 2 litres/km with cargo. Experience the last five seasons (1995-2000) shows that fuel consumption for bandwagons during an expedition will be between nil[14] and 17,000 litre depending on the size of the expedition, and whether there are field parties that will utilize band wagons in their work. Some emission values for bandwagons are given in Appendix 2.
- Snowmobiles: NARE utilizes various types of snowmobiles. No more than 15 snowmobiles are considered necessary for operations during the one and same season. The snowmobiles utilize gasoline (95 unleaded) with some oil mixed in, approx 0.3 litres/km. Experience the last five seasons (1995-2000) shows that fuel consumption for snowmobiles during an expedition will be between nil and 5000 litres, depending on the size of the expedition and the number of field parties utilizing snowmobiles in their work. Some emission values for snowmobiles are given in Appendix 2.

[14] Band wagons are normally not utilized during the intermittent expedition seasons, i.e. two out of three seasons.

- Fuel storage. Fuel for bandwagon and snowmobile operations is stored at Troll and Tor. Environmental aspects regarding the fuel storage are covered in Chapter 7. Fuel is transported to the stations on the bandwagons.

6.2.4.3 Waste management framework

Waste management during ground transport operations will be in accordance with national regulations *Regulations Relating to the Protection of the Environment in Antarctica* and strategy/plan set out in *Antarctic Waste Management Handbook for Nordic Antarctic Operations*:

- All waste generated during transport will be collected and brought to the station for proper storage/removal.
- Human waste and spill water generated during ground transportation may be disposed of in ice-cracks or ice pits. No organic waste will be disposed of on ice-free ground.

6.2.4.4 Management of fuel and hazardous substances

Fuel management will be in accordance with national regulations *Regulations Relating to the Protection of the Environment in Antarctica*. No harmful products/substances will intentionally be disposed/emitted during transport operations. This does not preclude combustion emissions from vehicles, camp stoves and the like. The following additional aspects with respect to fuel and pollution management should be noted:

- Containment mats: Containment mats, on which fuel can be stored, have been developed to fit the transport sleds. Such mats are meant to retain any small spills that may occur during transport. Presently there are not sufficient mats available, and experience shows that the mats are damaged/torn during transport. Further initiatives will be taken to minimize risk of fuel spills during transport.
- Safety drum: Some safety drums are available in case a drum should start to leak during bandwagon transport. Initiatives will be taken to increase the number of safety drums in the NARE operations.

6.2.4.5 Conservation of flora and fauna

Transport operations will be conducted in such a manner that provisions related to the conservation of flora and fauna in the *Regulations Relating to the Protection of the Environment in Antarctica* are complied with, and harmful interference due to traffic will be avoided by adhering to guidelines set out in the "Nordic Environmental Handbook for Antarctic Operations".

6.2.4.6 Protected areas and historic remains

The *Regulations relating to the protection of the environment in Antarctica* are fundamental in considering air operations in relation to protected areas. No ground transport takes place in protected areas unless special permission has been granted.

6.2.5 Mitigation measures in place

The NPI, in co-operation with its Finnish and Swedish counterparts, has developed environmental guidelines that have relevance for ground transport operations. All use of bandwagons and snowmobiles in NARE operations will be required to adhere to these guidelines:

- Procedures for fuel storage, transfer and transport Appendix 5
- Oil Spill Contingency Plan (with Fuel spill response guidelines, attached here as Appendix 6).
- Waste Management Handbook including waste management strategy (short version of Waste Management Guidelines is attached in Appendix 7).
- Environmental Guidelines: flora, fauna and the natural environment Appendix 8).

The following mitigation measures will also be in place:

- All bandwagons and all field parties utilizing snowmobiles will be equipped with spill kits with basic spill response equipment.
- Personnel will be instructed in relevant provisions of the AER and any guidelines developed for the purpose.

6.2.6 Acts in contravention with the framework

No acts in contravention to the above-described framework shall occur during operations. It should be noted that non-intended acts in contravention with the framework is a result of an accident and might be considered an emergency situation.

6.3 Alternatives to activity

6.3.1 Not using ground transport during NARE

Not having ground transport during NARE is not considered a viable alternative if Norway is to continue to conduct its own terrestrial research programme in Antarctica. Ground transport is required for transportation of equipment and for field research.

Different temporal framework

The austral summer season is currently the only viable temporal framework due to station capacity and air and vessel transport.

6.3.2 Different geographic region

Norway's primary research interests in Antarctica have traditionally been focused in the area around and in Dronning Maud Land. This is likely to continue to be the main area of focus. Ground transport operations in other areas would not satisfy the national strategy for Antarctic research.

6.4 Identification and evaluation of impacts and proposed mitigative measures

The impacts identified in Table 3 are those impacts that can be expected assuming that ground transport operations are conducted in accordance with the framework defined in the above sections. A summary of those impacts that are unavoidable and which NPI believes should be accepted as such is presented in matrix form in Appendix 1.

Table 3: Potential Environmental impacts during Ground Transport

Impact	Description	Evaluation	Mitigation	References
Air				
Contamination due to burning of fossil fuel.	Compounds will be spread and diluted in the atmosphere. Contributes to the change in the composition of the global atmosphere.	**Certain** **Global** **Less than minor** **Transitory**	• Minimize use of vehicles to that which is necessary for operations.	> Refer to Appendix 2 for emission values
Ice-covered and ice-free ground				
Pollution of ice-covered ground due to small spill incidents.	Small fuel spills are to be expected during re-fuelling or due to small leaks, etc. Small areas of ice- or snow-covered ground may be contaminated. Oil spilled on ice-covered ground is likely to remain on the surface and slowly evaporate, while spills on snow covered ground will likely seep into the snow/firn, and spread vertically and horizontally until it reaches the ground or an impermeable layer of ice.	**Very likely** **Local** **Less than minor** **Semi-permanent**	• Fuel handling guidelines. • Oil Spill Contingency Plan. • Use of containment tarps and/or collection boxes on sleds to contain any spill from drums. • Availability of safety drums.	> COMNAP (1999)
Pollution due to medium spill incidents.	Medium spills could occur as result of containers (drums, jerry cans, etc.) falling off sleds. Contamination will partly evaporate and partly be encapsulated in snow/firn.	**Possible** **Local** **Less than minor** **Semi-permanent**	• Fuel handling guidelines. • Oil Spill Contingency Plan.	> COMNAP (1999)

Table 3 Cont.

Impact	Description	Evaluation	Mitigation	References
Pollution due to larger spill incident.	Larger spills could occur as result of bandwagon/sled carrying fuel falling into a crevasse, which could result in damage of up to 40 drums of fuel, ie. 8000 litres of fuel. Such contamination would partly evaporate and partly become encapsulated in the snow/ice. Eventually remaining spill will be discharged wherever ice terminates and could potentially create local impacts on vegetation/soil/water at this point.	**Not likely** **Local** **No more than minor** **Permanent**	• Oil Spill Contingency Plan.	> COMNAP (1999)
Littering/pollution due to accidental loss of garbage.	Some littering may be expected due to carelessness, wind, etc. The amounts are likely to be so small that no accumulation of wastes will occur.	**Very likely** **Local** **Less than minor** **Semi-permanent**	• Routinely check for possible discharge points. • Routinely pick up loose waste so as to avoid it being taken by wind, etc.	
Changes to snow/ice covered surface due to vehicles.	Vehicles will impact snow/ice surface temporarily, although due to the low level of activity and the type of disturbance, natural processes should quickly 'resettle' the surface.	**Certain** **Regional** **Less than minor** **Transitory**		
Changes to ice-free surface due to vehicles.	Traffic on ice-free ground would entail structural damage to substrata. Due to slow natural processes in polar environment, tracks would remain visible over a long time.	**Not likely** **Local** **No more than minor** **Semi-permanent**	Transport on ice-free ground will be limited to only that which is necessary, and will at no time occur outside the station areas.	> Campbell, I.B. *et al.* (1993) > Råheim, E. (1992)

Table 3 Cont.

Impact	Description	Evaluation	Mitigation	References
Flora and Fauna				
Damage to vegetation due to traffic on ice-free ground.	Traffic on ice-free ground will damage any vegetation in the area of operation. Re-growth in areas damaged by vehicular traffic has been proved to be slow in cold polar environments.	**Not likely** **Local** **No more than minor** **Semi-permanent**	• Transport on ice-free ground will be limited to only that which is absolutely necessary, and only in the station areas.	> Forbes, B.C. (1998) > Råheim, E. (1992)
Disturbance of (nesting) birds due to noise from vehicles.	Birds that are approached by motorized vehicles will likely become stressed (increased heart rate, movement, flying off nest, etc.). At low level of vehicle disturbance (such that might be expected during NARE operations) individual birds may be affected (increased stress level, eggs/chicks taken by predators), but not populations.	**Possible** **Local** **Less than minor** **Transitory**	• The use of motorized vehicles within 200 metres of bird colonies will be avoided as much as possible.	> CAFF (1998)
Wilderness and aesthetic values				
Noise and visual pollution.	NARE ground transport is not expected to constitute noise or visual pollution as there are few, if any, people in the area to experience it as such	**Not likely** **Regional** **Less than minor** **Transitory**		

7 STATION OPERATIONS

7.1 Purpose and need

Operation of the field station Troll is considered essential in order to have a central base for Norwegian research activity in Antarctica. The station functions as the logistical 'hub' of the NARE operations and is essential for safety purposes. A separate environmental evaluation was conducted at the time of the establishment of the station (NPI, 1990).
Operation of the field station Tor is considered necessary in order to carry out the research that takes place in the bird colonies at Svarthamaren. Tor is also used as base for field parties that have their activity in the eastern parts of Dronning Maud Land.

7.2 Description of activity

7.2.1 Type of activity

The activity consists of the logistic related to operating the field stations, including such aspects as:

- Waste management
- Fuel management
- Power supply
- Water supply
- Accommodation
- Supply storage
- Maintenance of equipment

7.2.2 Geographic framework

The Troll station is located in Jutulsessen, Dronning Maud Land, at 72º00'S, 2º32'E, in the Mühlig-Hofmanfjella, Dronning Maud Land. Jutulsessen is located approximately 200 km from the ice edge.

The station Tor is located at Svarthamaren, at 71º53'S, 5º09'E, Mühlig-Hofmanfjella, Dronning Maud Land, approximately 240 km from the ice edge.

The locations of the stations are shown in Figure 2 (p.17).

7.2.3 Temporal framework

NARE station operations normally take place in the period medio November to medio March. Although the Troll station has been built to accommodate potential over-wintering teams, there have been no national overwintering expeditions so far.

7.2.4 Physical framework

Troll presently consists of one main building, one station unit (combined garage and living quarters) and two combined generator and shop buildings, as well as a glass fiber igloo. The main building houses up to 10 people, while additional personnel stay in the glass fiber igloo, the station unit or in tents. Troll is shown in Figure 3.

The station is equipped with a 15 kW (4 stroke) and a 46,4 kW (4 stroke) generator; the former consumes approx. 50-litre fuel per day, the latter approx. 100 litres at a higher effect. There is also a 4.5 kW back-up generator at the station.
There is a network of water pipes laid out, from the water reservoir to the generator building, from the generator building to the station unit, and from the station unit to the discharge point. The pipes are partly covered by gravel.

There are no structural installments for helicopter landing, fuel storage or waste storage.

Figure 3: Troll

Tor consists of one glass fiber igloo, one smaller wooden hut and one station unit (combined living quarters and garage). The station unit is of the same type as the station unit located at Troll. The station houses approximately 6 - 8 people. Tor is shown in Figure 4

The station is equipped with a Haze 4.5 kW generator, which consumes approx. 2 litres Jet A-1 per hour, and which is normally used approx. 10 hours a day.

There are no structural installments for helicopter landing, fuel storage or waste storage.

Figure 4: Tor

7.2.5 Operational framework

7.2.5.1 General

It is assumed that station operations will be conducted in accordance with the framework given below. If operations are significantly out of line with this framework, a separate IEE will be prepared for the activity.

7.2.5.2 Waste management framework

Waste management at the stations is in accordance with national regulations *Regulations Relating to the Protection of the Environment in Antarctica* and strategy/plan set out in *Antarctic Waste Management Handbook for Nordic Antarctic Operations*. In short, this entails that all waste, except waste water, is collected, separated and brought out of Antarctica for appropriate disposal or recycling. The following additional waste management aspects should be noted:

- Waste compressor: A waste compressor has been installed at Troll. The compressor reduces waste volume significantly and also enables compression of empty fuel drums to 20% of full size.
- Composting toilet: A compost toilet has been installed at Troll. The system enables significant reduction of the volume of human, food and paper waste. The system is in the 2000 season still under testing, but preliminary results seem to indicate that the composting toilet functions according to purpose.
- Waste water effluent at Troll: A system for purifying/treating wastewater has been installed at Troll. Treated wastewater is expected to reach near drinking water quality and can in principle be reused for cleaning purposes and such. The system is still being tested, but preliminary results seem to indicate that the treatment system functions according to purpose.
- Disposal of waste[15]: Arrangement for disposal of waste in South Africa will be made in advance of the expedition. Agreements will be made with relevant recycling companies and waste management companies. The companies will be required to confirm in writing what amount of waste has been received and that it has been treated in accordance with the agreement.

7.2.5.3 Energy management

Power supply at the stations is mainly based on generators and Jet A-1 consumption. The following aspects should be noted:

- Alternative energy/fuel: In addition to traditional fuel is propane now utilized for heating, water heating and for the kitchen stove at Troll.
- Utilization of waste heat: At Troll waste heat from the generators is utilized for heating water. A heating 'tub' has been installed in the generator buildings.
- Fuel consumption: Assuming that only the 46.6 kW generator is utilized during a season, the maximum fuel consumption for a 75 day season can be expected to be 7500 litres of fuel at Troll. At Tor a consumption of approximately 1500 litres can be expected.
- Operating hours: At least one generator at Troll is expected to operate at all times. The generator at Tor is normally operated 6-10 hours per day.

7.2.5.4 Management of fuel and hazardous substances

Fuel management is carried out in accordance with national regulations *Regulations Relating to the Protection of the Environment in Antarctica*. No harmful products/substances will be deliberately disposed/emitted during station operations. This does not preclude combustion emissions from generators, vehicles and the like. The following additional aspects with respect to fuel and pollution management should be noted:

- Fuel depot: The fuel depot at Troll is currently located on the ice-free ground between the ice and the garage unit. At Tor the fuel depot is located approx. 50 metres northwest of the station on snow-covered

[15] Reference is also made to the Basel Convention on the control of Transboundary Movements of Hazardous Wastes and their disposal. The NPI, in cooperation with its Finnish and Swedish counterparts, has initiated a process to consider the application of the Basel Convention to waste generated in Antarctica.

ground. Containment mats, on which fuel can be stored, have been introduced to both Troll and Tor. Such mats are meant to retain any small spills that may occur during storage (see

- Figure 5). These mats have proved to function according to purpose. Furthermore, safety drums are available at Troll and Tor for immediate protection for damaged drums. Presently there are not sufficient mats for all drums stored at Troll. Further initiatives will be taken to secure the fuel storage depot at Troll. Empty fuel drums are compacted to reduce volume of waste. There will always be a few litres of fuel left in all fuel drums, and consequently a containment system has been constructed for the compacting operations, so that no waste fuel contaminates the environment.
- Helicopter pads: Containment mats for helicopters have been developed. At Troll all helicopter landings, re-fuelling, maintenance, etc. will take place on such containment mats in order to reduce pollution into the environment.
- Waste water: Wastewater is treated before it is discharged (see 7.2.4). Regular monitoring/analysis of the wastewater will take place to ensure that any water discharged does not contain harmful concentrations of pollutants.

Figure 5: Fuel depot at Tor utilizing containment mats

7.2.5.5 Conservation of flora and fauna

Station operations will be conducted in such a manner that provisions related to the conservation of flora and fauna in the *Regulations Relating to the Protection of the Environment in Antarctica* are adhered to. The following additional aspects with respect to conservation of flora and fauna should be noted:

- Vegetation: The areas immediate surrounding the stations (radius of approx. 500 m) are considered as disturbed areas and pedestrian activity will not be restricted in these areas. No rare occurrences have been registered close to Troll or Tor, and consequently such disturbance is not considered significant. Vehicle traffic on ice-free ground will be kept to a minimum, but is necessary for supply and construction purposes.
- Bird colonies: The bird colonies close to the stations will not be visited unless in connection with approved research. When utilizing motorized vehicles personnel shall keep a distance of at least 200 metres from bird colonies. Aircraft and helicopter traffic to the stations will be kept to a minimum, and care will be taken to keep a distance to the nearby bird colonies. At Tor it will be necessary to approach

the bird colonies closer than the 2000 metres specified in the guidelines[16] when equipment and personnel are brought in for the season, but other flights to the station will as far as possible adhere to the given guidelines.

7.2.5.6 Protected areas and historic remains

The *Regulations relating to the protection of the environment in Antarctica* are fundamental in considering activity in protected areas. The station Tor is located as an enclave in SSSI No. 23 (Svarthamaren). Occupants at Tor will not be permitted to enter the protected area unless permit has been granted for their research activity.

7.2.5.7 Upgrading and expansion

Major structural changes or operational changes to the station operations described above will be considered in separate IEEs. At Troll, minor structural changes taking place within 100 metres of the centre of the station area, and which have been considered not to have any significant impact (less than minor or transitory), will be implemented without the preparation of a separate IEE.

7.2.6 Mitigation measures in place

- The NPI has, in co-operation with its Finnish and Swedish counterparts, developed environmental guidelines that have relevance for station operations. NARE station operations will be carried out in accordance with these guidelines:
  - Procedures for fuel storage, transfer and transport Appendix 6).
  - Oil Spill Contingency Plan (with Fuel spill response guidelines, attached here as Appendix 8).
  - Waste Management Handbook including waste management strategy (short version of Waste Management Guidelines are attached in Appendix 9).
  - Environmental Guidelines: flora, fauna and the natural environment (Appendix 10).
  - Guidelines for operations of small aircraft and helicopters in Antarctica. A short version of the guidelines is attached as Appendix 4).

- Both Troll and Tor are equipped with spill response equipment.

- Personnel and expedition members will be instructed in relevant provisions of the AER and any guidelines developed for the purpose.

7.2.7 Acts in contravention with the framework

No acts in contravention to the above-described framework shall occur during operations. It should be noted that non-intended acts in contravention with the framework is a result of an accident and might be considered an emergency situation.

7.3 Alternatives to activity

7.3.1 Not using the stations

Operation of Troll is considered essential for safety purposes during NARE operations. The expedition doctor is stationed here and medical equipment and facilities are located here. The station furthermore serves as communication base for all field parties.

Operation of Tor is considered an essential aspect of the research that takes place in the bird colonies at Svarthamaren. The research activity is prioritized in the strategic plan, and it has been considered important to have station facilities available. The alternative would be to build up an extensive field camp every season.

[16] Nordic environmental guidelines for operations of aircraft and helicopter in Antarctica.

7.3.2 Alternative operational framework

The present operational framework has been considered to be a framework that takes into account both operational, economic and environmental aspects. The operational framework is, however, constantly evaluated, and new initiatives will be taken to further reduce environmental impact, as well as increase operation efficiency. Presently energy management and fuel management are those aspects that are considered to possibly have the largest potential for improvement, i.e. by introducing alternative energy sources and improving storage systems for fuel. In 1999 the NPI did a preliminary survey of potential energy source alternatives, but has presently put these alternatives on hold due to high cost/benefit ratio. Further investigations will be made with respect to these aspects.

7.4 Identification and evaluation of impacts and proposed mitigative measures

The impacts identified in Table 4 are those impacts that can be expected assuming that station operations are in accordance with the framework described in the above sections. A summary of those impacts that are certain and probable, and which NPI believes should be accepted as such, is presented in matrix form in Appendix 1.

Table 4: Potential Environmental Impacts from Station Operations

Impact	Description	Evaluation	Mitigation	References
Air				
Contamination due to burning of fossil fuel (primarily energy, but also transport).	Compounds will be spread and diluted in the atmosphere. Contributes to the change in the composition of the global atmosphere.	**Certain** **Global** **Less than minor** **Transitory**	• Transportation and power generation limited to that which is necessary.	> Refer to Appendix 2 for emission values
Ice and ice-free ground				
Deposition of combustion compounds.	Studies show that deposition compounds only have a local extent. Soot deposition has been shown to cause no measurable changes of snow albedo at the South Pole Station. Local deposition of particles on the snow and ice surface will gradually be buried due to accumulation of snow (the accumulation rates varies accross all of Dronning Maud Land; eg. annual accumulation varies from 271 mm we. at Fimbulisen to 24 mm we. at 2840 m a.s.l. along a surveying traverse in the area between 70ºS, 5ºE and 75ºS, 15ºE). The fate of the contaminants on ice-free ground is not well documented.	**Certain** **Local** **Less than minor** **Semi-permanent**	• Transportation and power generation outside that which is considered necessary shall be limited.	> Suttie, E.D and E.W. Wolff, (1993) > Warren S.G. and A.D Clarke (1990) > Isaksson, I. *et al* (1999)

Table 4 Cont.

Impact	Description	Evaluation	Mitigation	References
Fuel contamination due to small spills.	Small fuel spills are to be expected during re-fuelling or due to small leaks, etc. Small areas of ice-covered ground may be contaminated. Spill will partly evaporate and partly be encapsulated in snow (drains vertically until an impermeable ice layer or ground is reached). Oil spilled on ground will seep into the underlying material. Clean-up of such spills is difficult. Natural decomposition has been shown to be slow.	**Very likely** **Local** **Less than minor** **Permanent**	• Guidelines for fuel storage, handling and transfer to avoid fuel spills. • Oil spill contingency plan to minimize extent and consequences of fuel spills.	> Gore, D.B. *et al.* (1999)
Pollution due to medium spill incidents.	Medium spills (< 200 litres) could occur as result of damage to containers (drums, jerry cans, etc.) during operations. Due to slow natural decomposition processes, pollutants that do not evaporate or cannot be mechanically removed, would remain in the substrata or snow/ice over long time.	**Possible** **Local** **No more than minor** **Semi-permanent**	• Fuel handling guidelines. • Oil Spill Contingency Plan.	> Gore, D.B. *et al.* (1999)
Contamination due to discharge of non-treated waste water.	A build up of contaminated ice could occur should non-treated water by acceident be discharged. Ablation is high in the area, and contaminated ice could evaporate before concentrations become unacceptable.	**Not likely** **Local** **Less than minor** **Transitory**	• Analysis of waste water before discharge. • Regular visual inspection of discharge area in order to terminate discharge if unusual discoloration. • Only biodegradable detergents/soaps will be used.	

Table 4 Cont.

Impact	Description	Evaluation	Mitigation	References
Structural changes to substrate due to discharge of waste water.	Ice will build up where the waste water is discharged. Ablation is, however, high in the area, and build-up is expected to be slow. The structural changes due to ice build-up could, with time, have further consequences with respect to the local micro-environment.	**Certain** **Local** **Less than minor** **Permanent**	• Regular visual inspection of discharge area to assess impact of structural change.	
Freshwater				
Fuel spills migrating into drinking water reservoir.	The drinking water reservoir at Troll is located downhill from fuel depot, as well as close to current landing spot for helicopters. Spilt fuel has proven to migrate into the water reservoir. This is an operational setback as other drinking water sources are not easily accessible. Contamination will remain in reservoir over a long period due to a likely lack of water exchange in the reservoir.	**Likely** **Local** **No more than minor** **Semi-permanent**	• Guidelines for fuel storage, handling and transfer to avoid fuel spills. • Continue the work to secure fuel depots so that any spills are retained.	• NIVA (2000)
Flora and Fauna				
Harm vegetation due to deposition of combustion products.	Studies show that deposition compounds only have a local extent. Lichens and mosses are however well known to take up contaminants from the air, and should in the areas in the immediate vicinity of the station be expected to do so. This may impact growth and distribution in the long run.	**Likely** **Local** **No more than minor** **Semi-permanent**	• Transportation and power generation outside that which is considered necessary shall be limited.	> Poblet, Al *et al.* (1997)

Table 4 Cont.

Impact	Description	Evaluation	Mitigation	References
Damage to vegetation cover due to pedestrian traffic.	Pedestrian traffic in the station area (radius 500 metres) is unavoidable. Such traffic will impact any vegetation in the area. Re-growth in such damaged areas will be slow. Due to relatively low number of people present over a limited time period the consequences are not expected to be considerable. No unique species have been registered in the area.	**Certain** **Local** **Less than minor** **Semi-permanent**	• Environmental Guidelines: flora, fauna and the natural environment.	> Campbell, I.B. *et al.*. (1998) > Campbell, I.B. *et al* (1993) > Komarkova, V. (1983)
Disturbance of (nesting) birds due to human presence.	Presence in the station area will to one degree or the other disturb birds in the immediate vicinity of the station. Disturbed birds react by becoming stressed (increased heart rate, movement, flying off nest, etc.). At low level of disturbance (such that might be expected during NARE operations) individual birds may be affected, but not populations.	**Likely** **Local** **Less than minor** **Transitory**	• Environmental Guidelines: flora, fauna and the natural environment	> CAFF (1998)
Spread of disease from people/equipment/food/ garbage.	Human activity can be the cause of disease outbreaks, bringing pathogens unintentionally into Antarctica. So far few, if any, disease outbreaks are however known to have been introduced to Antarctica as a result of human activity.	**Not likely** **Regional** **[More than minor** **Permanent]** *	• Information before departure to Antarctica to expedition members. • Waste management procedures in accordance with waste management strategy. • No direct contact with animals is permitted.	> Knowles, K. *et al.* (1999) > Gardner *et al.* (1997)

* Square brackets denotes a large degree of uncertainty in evaluation

Table 4 Cont.

Impact	Description	Evaluation	Mitigation	References
Establishment of non-native organisms.	There are well-known examples of experimental and accidental introductions of non-native organisms in Antarctica. Although it is considered unlikely that non-native organisms will establish in the NARE operational area (due to the low temperatures), the risk should be taken into consideration.	**Not likely** **Local** **[No more than minor** **Permanent]**	• Information before departure to Antarctica to expedition members.	> Smith, R.I.L. (1996)
"Loose" waste in the environment.	Some littering may be expected due to carelessness, wind, etc. The amounts are likely to be small, but waste constitute a threat to individual birds if they eat, get caught in packing bands, cut themselves on sharp edges, etc.	**Possible** **Local** **Less than minor** **Transitory**	• Waste management procedures in accordance with waste management strategy. • Regular "Chicken-runs", esp. before storm and at end of season.	> Wang. Z.P. and F.I. Norman (1993)
Wilderness and aesthetic values				
"Loose" waste in the environment due to wind, being forgotten, carelessness, etc.	Some littering may be expected due to carelessness, wind, etc. The amounts are likely to be small. Loose waste will constitute visual pollution. Since there are few people in the area such littering can hardly be considered visual pollution.	**Likely** **Local** **Less than minor** **Permanent**	• Waste management procedures in accordance with waste management strategy. • "Chicken-runs", at least at end of season.	

Table 4 Cont.

Impact	Description	Evaluation	Mitigation	References
Discoloration of ice at point of waste water discharge	If problems arise with the wastewater treatment system, discolored water could over a short time period be released into the environment. Ablation is high in the area, and discolored ice will likely evaporate before concentrations become a visual disturbance.	**Not likely** **Local** **Less than minor** **Semi-permanent**	• Regular visual inspection of discharge area in order to terminate discharge if unusual discoloration.	
Noise or visual pollution due to operations	NARE station operations are not expected to constitute noise or visual pollution as there are few, if any, people in the area to experience it as such.	**Not likely** **Regional** **Less than minor** **Transitory**		

8 CUMULATIVE IMPACTS

The activity level is limited in the area of Dronning Maud Land where the NARE operations take place. Finland and Sweden each have a small research station where a limited amount of activity occurs. South Africa and Germany have year-round stations in the area (SANAE IV and Neumayer), and in eastern Dronning Maud Land there are Indian, Japanese and Russian operations. The overall concentration of people in Dronning Maud Land is, however, very low. All together these various activities will have a cumulative impact, but due to the low level of activity it is expected that the overall consequences will be of limited significance. The largest consequences may be for the research activities themselves, as e.g. pollution resulting from the operations may impact measuring results etc.

The cumulative effects of just the NARE operations are expected to be quite limited in extent. Norwegian expeditions of significance are arranged only every third year, and the concentration of impacts is low in the area. The matrix in Appendix 1 gives an overview of the expected impacts according to likeliness and level of impact.

The greatest cumulative impact is likely to occur in the area surrounding the stations Troll and Tor. Envisioned cumulative impacts include:

- An accumulation of areas contaminated by small fuel spills in the station areas, both on ice-free and ice-covered ground.
- Deposition of combustion products from operation of generators and transport, especially affecting lichens and mosses in the station areas.
- A build-up of ice at point of discharge of wastewater, with a possible change in the microenvironment in the long run.

All in all the Norwegian research expedition to Antarctica will have no more than a minor or transitory effect on the environment.

9 MONITORING

A separate monitoring protocol is under preparation for the NARE operations[17]. The aims of the monitoring programme are to:

- assess whether the actual impacts from NARE activity are as anticipated in the Initial Environmental Evaluation
- establish the geographic extent of impact, and assess any changes to this "footprint"
- provide a basis on which to initiate processes to mitigate and minimize impacts
- assess changes in intensity of activity
- ensure that the activity is carried out in accordance with international agreements and national legislation

10 CONCLUSION AND RECOMMENDATION

It is concluded that the unavoidable environmental impacts of NARE operations will be of no more than a minor or transitory character. The NPI therefore recommends that the proposed activity continues to take place as described, under the condition that the activity is conducted in accordance with the given framework, that the mitigative measures described in the IEE are adhered to, and that an appropriate monitoring protocol is prescribed. Operations that are not in line with the description of this document should be covered by a separate IEE or CEE.

[17] Presently under development: “Environmental monitoring programme for the Norwegian Antarctic Research Expeditions

Appendix 1: Overview of impacts associated with the activity that are to be considered as acceptable impacts

Incidents identified as having more than minor impact, but considered 'not likely' to occur shall not be considered acceptable impacts. Any incidents of this type is a result of negligence or an emergency situation. In the matrix below they are marked with grey.

Probability/Impact	Less than minor	No more than minor	More than minor
Certain	Contamination of air due to combustion of fossil fuels (terrestrial and marine) and waste (marine only)		
	Contamination of ice and substrata due to deposition products from combustion of fossil fuels (terrestrial)		
	Change to snow/ice covered surface due to vehicle traffic (terrestrial)		
	Structural changes to substrata due to discharge of waste water (Troll)		
	Damage to substrata and vegetation due to pedestrian activity (terrestrial)		
Very likely	Contamination of ice and substrata due to small fuel spills (terrestrial)		
	Littering due to 'accidental' loss of small amounts of garbage (terrestrial and marine)		
Likely	Contamination of ice and substrata due to medium fuel spills		
	Contamination of water due to accidental discharge of small amounts of fuel and oil contaminated water (marine)		
	Disturbance of (nesting) birds due to human presence (terrestrial)		
	Visual pollution due to littering (terrestrial)		
		Pollution of drinking water due to fuel spil (Troll)	

Appendix 1 Cont.

Probability/Impact	Less than minor	No more than minor	More than minor
Likely (cont.)		Damage to vegetation due to deposition products from combustion of fossil fuels (terrestrial)	
Possible	Harm birds due to loose garbage in the environment (terrestrial)		
	Contamination of ice due to paint from vessel hull (marine)		
	Contamination of ice and substrata due to medium fuel spills (terrestrial)		
	Disturbe birds due to noise from vehicles (terrestrial)		
		Disturbance to animals due to noise (marine and terrestrial)	
Not likely	Contamination of ice and substrata due to large fuel spills (> 200 litres)		
	Visual pollution due to build-up of ice from discolored waste water (Troll)		
	Noise and visual pollution (marine and terrestrial)		
	Contamination due to discharge of non-treated waste water		
		Contamination of ice and substrata due to large fuel spills (terrestrial)	
		Damage to substrata due to vehicle operation (terrestrial)	

Appendix 1 Cont.

Probability/Impact	Less than minor	No more than minor	More than minor
Not likely (cont.)		Damage to vegetation due to vehicle operation (terrestrial)	
		Harm flora/fauna due to fuel spills (marine and terrestrial)	
		Establishment of non-native organisms	
			Spread of disease due to human activity

Appendix 2: Average emission values per tonne fuel combusted

.

Machine/Substance	NO_x	NM-VOC	CH_4	SO_2	CO_2	N_2O		Expected consumption during NARE operation
Ships ♦ (MGO)	**65 kg**	**2.4 kg**	**0.2 kg**	**1.2 kg**	**3.17 tonnes**	**0.08 kg**		**Approx. 200 tonnes pr. marine expedition**
Zodiacs ♦ (Gasoline) **(two-stroke engines)**	**2 kg**	**500 kg**	**6 kg**	**0.16 kg**	**3.13 tonnes**	**0.02 kg**		**Max. 100 litres = 0.078 tonnes**
Hercules ♦♦ (Jet A-1)	**7.7 kg**	**4.5/2.6/0.4 kg**	**0.6 kg** (0 during cruise)	**0.46 kg**	**3.15 tonnes**	**0,1 kg**		**3 round-trips (south of 60º S) = 9300 litres = 7.4 tonnes** (Poles Apart, 1997)
Small aircraft ♦♦ (Jet A-1)	**4.4 kg**	**4.5/2.6/0.4 kg**	**0.6 kg** (0 during cruise)	**0.46 kg**	**3.15 tonnes**	**0.1 kg**		**Approx. 10 hours (a 350 l/h) = 2.8 tonnes** (Poles Apart, 1997)
Helicopter♦♦(Jet A-1)	**7 kg**		**0.6 kg** (0 during cruise)	**0.46 kg**	**3.15 tonnes**	**0.1 kg**		**Average: 75 hours (a 200 l/h) = 15 tonnes**
Snowmobiles ♦ (Gasoline)	**3 kg**	**368 kg**	**5.9 kg**	**0.2 kg**	**3.13 tonnes**	**0.06 kg**		**Max. 6000 litres = 4.68 tonnes**
Bandwagons (Jet A-1)					**3.15 tonnes**			**Max. 17,000 litres = 13.6 tonnes**
Generators♦♦♦ (Jet A-1)	**40.4 kg**	**6.7 kg**		**0.1 kg**	**3.18 tonnes**			**Max. 7500 litres = 6 tonnes for a 75 day season**

♦ Source: SSB, 2000

♦♦ Source: SSB, 1997

♦♦♦ Source: NPI, 1989

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Appendix 4: Summary guidelines for helicopter and aircraft operations

Summary guidelines
Helicopter and aircraft operations

1.Wildlife

- Helicopters and small aircraft should not land or fly within 2000 metres horizontal and 2000 metre vertical separation of concentrations (20 or more animals) of birds and seals.
- When helicopters or aircraft are to be used closer to colonies/rookeries than the above stipulated 2000 metres, they should preferably not be used during incubation and weaning.
- All helicopters and aircraft should maintain a 300 metre vertical and horizontal separation limit above and around whales.
- If weather conditions make it impossible to maintain the minimum separations, then the flight should be postponed if possible.
- When approaching land, a flight path as low to the horizon as possible should be chosen. Seabirds are more alarmed by helicopter and aircraft above them than low to the horizon.
- Helicopters and small aircraft should always land downwind of wildlife concentrations to minimise disturbance due to noise, dust and exhaust fumes.
- In unfamiliar areas care should always be taken in order to avoid flying over concentrations of wildlife.

2. Lakes

- Helicopters and small aircraft should avoid flying over known lakes at altitudes of less than 500 metres or operate upwind of lakes, even when frozen, to prevent dust and exhaust fumes from settling on lake surfaces.

3. Vegetated areas

- Helicopters and aircraft should not land on, or immediately upwind of, vegetated areas, this in order to avoid physical damage to, or dust and exhaust fumes settling on vegetation.

4. Station Areas

- See the site specific guidelines pertaining to use of helicopters and aircraft at the Nordic stations.

5. Protected Areas and Managed Areas

- Most Antarctic Protected and Managed Areas have strict regulations with respect to helicopters and aircraft. Before approaching, flying over or landing in a designated Protected or Managed Area, consult the management plan for the site in question.

6. Refuelling and Maintenance

- Scheduled refuelling and aircraft maintenance work should whenever possible be undertaken at fixed sites. At the Nordic stations these fixed sites are equipped with an absorptive mat or other foundation that will prevent large and small spills from reaching the ground.
- Refuelling is not to occur in Protected Areas unless such action is permitted through the management plan.
- Refuelling should not occur near concentrations of wildlife, lakes or vegetated areas unless helicopter or aircraft has been permitted to land near such areas in association with approved research.
- Fuel drums and other equipment must be removed from field sites at the conclusion of the refuelling and maintenance operations.
- All helicopters and aircraft are to have the following equipment available in order to clean up spills from the refuelling/maintenance operations:

  absorption mats/pillows

  plastic bags to dispose of soiled equipment

Appendix 5: Procedures for fuel storage, transfer and transport

Procedures for fuel storage, transfer and transport

Fuel spills in Antarctica can cause long-lasting environmental damage. The physical conditions in Antarctica retard the decomposition of the fuel products, and clean-up efforts are made difficult by the conditions as well.

The best strategy is to prevent spills from happening in the first place. This means that any person handling fuel in Antarctica has a certain responsibility to ensure that spills do not occur. All expedition members should therefore be aware of the guidelines outlined below and act accordingly.

1. Fuel Storage

- ✓ Fuel must not be stored in the vicinity of environmentally sensitive areas, i.e. vegetated areas, fresh water, bird colonies, etc.
- ✓ Store all containers, drums, etc. in such a way that any drips, leaks and spills will not enter into the environment. An accumulation of such minor releases can easily add up to unnecessary contamination.
- ✓ Fuel shall only be stored in containers specifically designed for the products being stored, and suitable for the prevailing climatic conditions.
- ✓ Containers must not leak, and must be sealed with a proper fitting lid or cap.
- ✓ Keep lids, valves, etc. tightly closed except during transfer of fuel.

2. Transport of fuel

- ✓ During transport all drums must be transported upright and properly secured to the vehicle to prevent shifting or swaying in any manner. All drums should be tied down with adjustable straps to restrict any shifting of the load.
- ✓ Containers of 20 litres or less should be stored in leak proof storage box during transport. This will keep the containers from bouncing out of the vehicle and will contain any spillage that may occur from small leaks.
- ✓ Maintain appropriate spill handling equipment with the transport vehicle. If leaks and spills are noticed, these should be stopped and contained immediately. Fuel from leaky or damaged containers should be transferred to un-damaged containers or to a safety drum.

3. Handling & Transfer of fuel

- ✓ Re-fuelling should as far as possible occur sheltered from the wind.
- ✓ During fuel transfer absorbent material should always be available. Fuel spills and leaks shall be removed with the aid of absorbents and disposed of in an approved manner.
- ✓ During fuel transfer operations absorbent mats should as far as practicable be used to avoid accidental spills to the ground.
- ✓ All spills and leaks must immediately be contained, cleaned and disposed of in an approved manner according to procedures described in the Oil Spill Contingency Plan (OSCP).
- ✓ Ensure that all spills are to be reported according to the procedures described in OSCP. Spills larger than 200 litres are to be reported to expedition leader immediately.
- ✓ All sources of ignition must be eliminated or removed while refuelling.

4. Maintenance & Inspection

- ✓ Fuel containers should be superficially (visually) checked for leaks and spills by any person having errands in the fuel storage area.
- ✓ All fuel storage drums are to be thoroughly inspected on a weekly basis, and as soon as possible following adverse weather. The storage drums and storage area should be checked for leaks, spills, deformed drums, etc. Any leakag
- ✓ shall be repaired as quickly as possible.

Appendix 6: Fuel Spill response guidelines

Fuel spill response guidelines

1. Initial assessment
The observer of the spill must carry out an initial assessment of the situation. He/she must check the:

1) Probable quantity of fuel spilled
2) Type of fuel
3) Location of the spill
4) Probable source and cause
5) Risk of fire or harm to human health

2. Initial notification
If spill is assessed to be larger than 200 litres the observer of the spill must notify expedition leader and communicate the information obtained in the initial assessment.

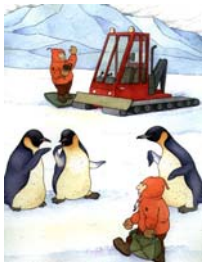
3. Response team
If spill is assessed to be less than 200 litres, observer initiates further response alone or with present personnel. Observer should request additional personnel if deemed necessary.

If spill is assessed to be larger than 200 litres, the Expedition Leader must decide on the most appropriate response strategy and ensure the presence of adequate personnel to take care of the spill. It is the duty of the selected personnel to protect:

1) Health and safety
2) Station facilities
3) Threatened resources

4. General clean-up procedures
Although each oil spill is different, general common procedures are outlined below:

- ✓ Ensure oil spill equipment is in a known and accessible location.
- ✓ If a spill occurs, stop or minimise any further spillage. Ensure safety of all personnel. Check for fire and explosion risk. Ensure safety equipment is worn.
- ✓ For all spills, deploy absorbents to contain fuel if possible. It may be possible to hold fuel in depressions by using absorbent materials, or by building small dams.
- ✓ If possible use pump to remove fuel from ground straight into 200 litre drums. Ensure that sufficient good quality empty drums are available near the spill site.
- ✓ Put absorbent pads on any remaining fuel or oil outside which cannot be pumped or manually removed. Oil soaked absorbents must be picked up and put into plastic bags and/or empty 200 litre drums.
- ✓ Contaminated snow can be stored in 200 litre drums which have had their tops removed. Allow the snow to melt and decant off fuel.
- ✓ Any waste drums containing a mixture of fuel and snow or water are likely to freeze. To prevent drums from splitting, use only those in good conditions. Do not fill completely.
- ✓ Drums of recovered fuel/water, oil soaked absorbents and contaminated clothing must be sent for disposal outside Antarctica. Follow the disposal instructions given in the Nordic Waste Management Handbook.



Appendix 7: Waste management guidelines

Waste Management Guidelines

1. Waste Minimization

- ✓ Minimize purchase of products with plastic, glass or other bulky packaging material.
- ✓ Buy durable products instead of disposable products.
- ✓ Get rid of unnecessary packaging material (especially plastic) before leaving for Antarctica.
- ✓ Substitute shredded paper, polystyrene chips, beads and other similar loose packaging material with bubble wrap, cardboard or paper.
- ✓ Buy products that easily can be re-used for other purposes.
- ✓ Use packaging material that can be re-used.
- ✓ Re-use products/material whenever this is practicable.

2. Waste Removal

- ✓ No waste is to be disposed of in Antarctica unless special permission has been granted.
- ✓ No open burning of waste is allowed.

3. Environmentally harmful products

- ✓ Polychlorinated biphenyls (PCB), non-sterile soil, polystyrene chips/beads and similar forms of packaging material, pesticides (except that which is necessary for research or medical/hygienic reasons) are not to be brought to Antarctica.
- ✓ The use of polyvinylchloride (PVC) products is highly discouraged.
- ✓ The introduction of non-native (non-indigenous) species of animals and plants (including seeds) and any non-native microorganisms (including viruses, bacteria, parasites, fungi and yeast) requires a special permit.
- ✓ Products and substances that have a potential harmful environmental effect should be treated with special attention so that no emission and dispersal occur.

4. Separation of waste

- ✓ Waste is to be separated into the following categories:

BLUE	metal waste
GREEN	glass waste
ORANGE	mixed solid wastes
BLACK	sewage and food waste
BROWN	liquid kitchen waste/waste water

4.1 Sewage

- ❖ Discharge of sewage is prohibited under all circumstances unless the project has been granted exemption.
- ❖ Under no circumstances must sewage or domestic liquid waste be disposed of in vegetated areas or in areas with discharge to fresh water.

4.2 Hazardous waste

- ❖ Different categories of hazardous wastes should never be mixed together in the same drum or crate.
- ❖ Oil-contaminated soil/water/fabric is to be stored in separate containers (labeled oil polluted soil/water/fabric).

4.3 Solids to be combusted

- ❖ No burning is allowed

4.4 Radioactive waste

- ❖ For both liquid and solid radioactive waste it is essential that the correct information is provided in the labelling of the containers.

Appendix 8: Environmental guidelines: flora, fauna and the natural environment

Environmental Guidelines: Flora, fauna and the natural environment

Human activity can have a large impact on the vulnerable natural environment in Antarctica. Show respect, and do your utmost to ensure that your presence does not harm the environment unnecessarily.

1. Plants

- ✓ Plants in Antarctica are rare, fragile and grow slowly. Therefore you should avoid areas where mosses and lichens grow. Use established paths and trails where these exist.
- ✓ Establish camps in non-sensitive areas
- ✓ It is prohibited to collect plants without a special permit.
- ✓ It is prohibited to bring plants to Antarctica.

2. Animals

- ✓ Keep distance to animals, and be quiet and calm in their presence. Be especially alert in periods when animals breed. Do not walk through bird and seal colonies unless you are conducting approved research in the area. Avoid use of motorised vehicles closer than 200 metres from any animal.
- ✓ Do not feed, touch or handle birds or seals, or approach or photograph them in ways that cause them to alter their behaviour.
- ✓ It is prohibited to collect animals without a special permit
- ✓ It is prohibited to bring animals to Antarctica

3. Natural environment

- ✓ Do not paint on rocks or boulders, or in any other manner deface these.
- ✓ Avoid collecting or taking away geological specimens as a souvenir, including rocks, bones, fossils.
- ✓ When leaving a site it should be left in a natural state. Go thoroughly through the area before you leave, and remove waste and other left behind effects.

4. Protected areas and historic artefacts

- ✓ Always check whether there are Antarctic Specially Protected Areas (ASPA), Antarctic Specially Managed Areas (ASMA), Sites of Special Scientific Interest (SSSI) or registered historic sites and monuments in the areas you are staying in.
- ✓ Special permits are required for entering or engage in activity in ASPAs and SSSIs. The permit must be with you in the field.
- ✓ Most protected areas have management plans. It is your responsibility to familiarise yourself with and adhere to existing requirements and rules as they are articulated in the management plans.
- ✓ Cultural remains shall not be damaged, destroyed or removed.